

CLAIMS

THAT CLAIMED IS:

1. A well pump assembly for pumping a mixed flow of liquid and gas, comprising:
a conditioning impeller having a hub with a bore for engaging a shaft for rotation therewith in a forward rotation direction;
a stationary conditioning diffuser juxtaposed with the conditioning impeller to receive fluid from the impeller, the diffuser having a plurality of blades that incline from a downstream side to an upstream of the diffuser in a rearward rotational direction; and
a plurality of impeller vanes extending from the outer circumference of the hub of the conditioning impeller, each of the vanes inclining in the forward rotational direction from an downstream side of the impeller, defining a leading edge and a trailing edge, and wherein a radial line passing through an outer end of the leading edge of each of the vanes is rotationally forward of an inner end of the leading edge of each of the vanes for forcing liquid and gas radially inward and into the diffuser.
2. The well pump assembly of claim 1, wherein the leading and trailing edges of each of the impeller vanes are straight and parallel to each other.
3. The well pump assembly of claim 1, wherein each impeller vane is curved from the leading edge to the trailing edge.
4. The well pump assembly of claim 1, wherein the leading and trailing edges of each impeller vane is parallel to and is offset from a radial line of the impeller that is located rotationally forward of the vane.

5. The well pump assembly of claim 1, wherein each diffuser blade is curved from the upstream side to the downstream side.
6. The well pump assembly of claim 1, wherein each diffuser blade comprises a portion that is curved in more than one of plane.
7. The well pump assembly of claim 1, wherein each impeller vane has a straight median line that is offset from the axis of the hub.
8. The well pump assembly of claim 1, further comprising:
 - a plurality of pumping impellers located downstream of the conditioning impellers for receiving the well fluid from the conditioning impellers and increasing the well fluid pressure, the pumping impellers having a plurality of curved passages; and
 - a pumping diffuser located between each pumping impeller and having a plurality of curved passages.
9. The well pump assembly of claim 1, further comprising a gas separator located downstream of the conditioning impeller, the separator having a rotating blade for forcing liquid in the well fluid outward relative gas in the well fluid within a central bore.
10. A well pump assembly for pumping a mixed flow of liquid and gas, comprising:
 - an outer casing with an axial centerline;
 - a shaft extending through a portion of the outer casing along the axial centerline of the casing;

a conditioning impeller having hub with a bore engaging the shaft for rotation therewith;
a conditioning diffuser stationarily mounted in the outer casing to receive fluid from the impeller, the diffuser having a plurality of blades that curve in an outward direction from an upstream side to a downstream side; and
a plurality of impeller vanes extending from the hub the impeller, each of the vanes having a straight edge that is parallel to and offset from a radial line of the impeller.

11. The well pump assembly of claim 10, wherein each impeller vane includes a leading edge and a trailing edge and is curved from the leading edge to the trailing edge.

12. The well pump assembly of claim 10, wherein the straight edge defines a leading edge having an outer end that is upstream of an inner end of the leading edge.

13. The well pump assembly of claim 10, wherein each diffuser blade is curved from an upstream side to a downstream side.

14. The well pump assembly of claim 10, wherein each diffuser blade comprises a portion that is curved in more than one of plane.

15. The well pump assembly of claim 10, further comprising:

a plurality of pumping impellers located downstream of the conditioning impellers for receiving the well fluid from the conditioning impellers and increasing the well fluid pressure, the pumping impellers having a plurality of curved passages; and

a pumping diffuser located between each pumping impeller and having a plurality of curved passages.

16. The well pump assembly of claim 10, further comprising a gas separator located downstream of the conditioning impeller, the separator having a rotating blade for forcing liquid in the well fluid outward relative gas in the well fluid within a central bore.

17. A well pump assembly for pumping a mixed flow of liquid and gas, comprising:

an outer casing with an axial centerline;

a shaft extending through a portion of the outer casing along the axial centerline of the casing;

a conditioning section for mixing gaseous well fluid entering the pump comprising: a conditioning impeller having a hub with a bore for engaging a shaft for rotation therewith in a forward rotation direction, a stationary conditioning diffuser juxtaposed with the conditioning impeller to receive fluid from the impeller, the diffuser having a plurality of blades that incline from a downstream side to an upstream side of the diffuser in a rearward rotational direction, and a plurality of impeller vanes extending from the outer circumference of the hub of the conditioning impeller, each of the vanes inclining in the forward rotational direction from an downstream side of the impeller, defining a leading edge and a trailing edge, and wherein a radial line passing through an outer end of the leading edge of each of the vanes is rotationally forward of an inner end of the leading edge of each of the vanes for forcing liquid and gas radially inward and into the diffuser.; and

a pump section for pumping the gaseous well fluid from the well, comprising: a plurality of pump impellers and pump diffusers.

18. The well pump assembly of claim 17, wherein each impeller vane is curved from the leading edge to the trailing edge.

19. The well pump assembly of claim 17, wherein the leading and trailing edges of each impeller vane is parallel to and is offset from a radial line of the impeller that is located rotationally forward of the vane.

20. The well pump assembly of claim 17, wherein each diffuser blade is curved from the upstream side to the downstream side.

21. A method for pumping a well fluid with mixed flow of liquid and gas, comprising:
rotating an impeller having a hub with a bore for engaging a shaft for rotation therewith in a forward rotation direction;

creating turbulence by forcing the well fluid radially inward against centrifugal forces with a plurality of impeller vanes extending from the outer circumference of the hub of the conditioning impeller that have an outer end of a leading edge of each of each the vanes that is rotationally forward of an inner end of the leading edge of each of the vanes; and

continuing to force the well fluid radially inward with a stationary conditioning diffuser receiving well fluid from the impeller and having a plurality of blades that incline from an upstream side to a downstream side of the diffuser in a rearward rotational direction.

22. The method of claim 21, further comprising conveying the well fluid to a set of pumping impellers for pumping the well fluid up a conduit.